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The optimum nutrition experiment Lisselbo. A brief description of an experiment in a young stand of Scots pine. *(Pinus silvestris L.)*

Näringsoptimeringsförsöket Lisselbo.
En kort beskrivning av ett försök med
växtnäringstillförsel till ung tallskog.

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ABSTRACT

Three fertiliser experiments laid out in 1968 in a young pine forest in the province of Gästrikland in middle Sweden are described.

Experiment E40 is a dosage experiment with nitrogen given as ammonium nitrate at three levels. Phosphorus and potassium are also applied to half of the number of plots.

Experiment E41 has a balanced block design for testing the effect of phosphorus, potassium, magnesium and sulphur in the presence of a nitrogen addition. A combined application of micronutrients has also been tried.

In experiment E42 the soil acidity has been changed and the effects on tree growth and soil are being studied. The soil acidity has been increased by application of dilute sulphuric acid (simulated accelerated effect of acid rain) or decreased by liming. Irrigation has also been tried in this experiment. All the treatments mentioned have been tested at two levels of nutrition, unfertilised and with NPK added.

Nitrogen is applied annually, the other elements at 3-4 years' interval. The foliage nutrient level is investigated annually by chemical analysis, which has shown that the application of nitrogen fertiliser rapidly increased needle nitrogen concentrations.

The treatments have so far had very little effect on the height growth of the trees. Application of nitrogen has, however, increased the basal area.

Soil samples have been collected at Lisselbo for studying nutrient status, ammonification, nitrification and soil fauna. A lysimeter installation furthermore is used to study leaching. The variation in dry weight and nutrient content of pine needles has been followed throughout the year. The aim of most of these special studies has been to study the effect of application of nitrogen as well as the effect of accelerated soil acidification.

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1. Objectives

The term optimum nutrition experiment is used in this context for a type of field experiment in which a wide range of combinations of nutrient applications is tested and in which foliage samples are collected and analysed to make it possible to follow and to a certain degree control the changes in internal nutrient level in the test plants. Nutrient applications are made at least annually, and the amounts added can be adjusted according to the results of the foliar analyses. An attempt is made to keep separate, and as far as possible, constant nutrient levels in the foliage over extended periods of time. Our studies include the behaviour of the primary producers as well as that of other components of the forest ecosystem.

Five forest optimum nutrition experiments exist in Sweden (Fig. 1). A brief description of one of these experiments, Stråsan, has been published recently (Tamm et al. 1974).

The experiments have been part of the Swedish IBP programme. (Project: Primary production and turnover in forest ecosystems with controlled nutrient status).

Grants for the investigations have been obtained from the Swedish Council for Forestry and Agricultural Research and from Stiftelsen Svensk Växtnäringsforskning.

2. Site description

The Lisselbo experimental area is situated on a glacifluvial eskar and its slope towards the West about 80 metres above sea level along road No. 254. The general topography of the region is rather flat. The area is below the highest coastline after the glaciation, and during the isostatic recovery of the land, the eskar was exposed to intensive wave action. The height difference between the top of the eskar and the surroundings is not more than five to ten metres in the area. The soil is sandy, and well to excessively well drained throughout the area (about seven hectares), but the texture of the sand varies from gravelly to fine sandy; particularly along the ridge of the eskar is there a high frequency of stones. Eskars are almost invariably covered with pine forest in this part of Sweden, often with an admixture of spruce and some hardwoods on the lower parts of the slopes. Mean monthly temperature and mean precipitation for the study area are shown in Fig. 2.

The former stand was destroyed by a storm in early 1954, which took down about one-third of the standing forest volume in the parish of Hedesunda where Lisselbo is situated. Although the windfelling released a number of selfsown young pine saplings, scarification and sowing was carried out in the spring 1955. The spacing of the young stand, consisting of both naturally regenerated and sown pines, was regulated in 1965 by removing a number of trees.

The experimental plots were laid out in 1968 and the treatments (except irrigation) started in the spring of 1969. The irrigation could not be started until the early summer of 1970. The area has been fenced against elk (moose). However, these have been able to pass the fence on some occasions (without doing much damage). Now most of the trees are so tall that browsing will no longer be very harmful.

3. Experiment description

The experimental area is divided into 72 plots, 30 x 30 m (Fig. 4; net plots 20 x 20 m).

The plots are assigned to three different experiments:

Experiment E40 (Tab. 1a, 32 plots). This is a nitrogen dosage experiment, with four replicates and with the various nitrogen levels either with or without a PK treatment.

Experiment E41 (Tab. 1b, 20 plots) is an experiment with balanced blocks, intended to test the effect of addition of P, K, Mg and S. All these elements are tested in the presence of a nitrogen addition, since former experiments show that Swedish pine forest on sandy soil responds to nitrogen, but not to mineral nutrients without nitrogen. Each of the blocks contains one additional plot which receives one of the treatments given in the block, together with a mixture of micronutrients. Micronutrients are not included in the normal factorial design because of the risk that microelement application might have deleterious effects, the range between suboptimum and supraoptimum levels for certain microelements being rather narrow.

Experiment E42 (Tab. 1c, 20 plots) contains on the one hand, plots with irrigation, and on the other hand, plots where soil acidity is manipulated in one direction or the other. pH increases are effected by lime application, while acidification is achieved by application of dilute sulphuric acid in two dosages. The aim is to simulate an accelerated soil acidification due to acid precipitation. All the mentioned treatments are tested at two nutrient levels: without fertilisation, and with an addition of nitrogen, phosphorus, and potassium. The irrigation experiment should be considered as a qualitative experiment only, to test whether an improvement in water regime affects growth. The plan for the experiment includes measurement of precipitation for ten-day periods in summer; whenever the precipitation during a ten-day period is below the normal for that period, additional water is given. The water comes from a nearby, rather oligotrophic, lake. (Tab. 2).

In addition to the plots now mentioned, there are other installations at Lisselbo. The lysimeters will be described below, but regular measurements are also made at Lisselbo of standard temperatures, and precipitation by a recording gauge. Some of the plots have litter traps and rain gauges, to measure interception and salt content of the water passing the canopy. The diameter growth of trees within several treatments has been followed by band dendrometers.

4. Needle analyses

Needle samples are collected each autumn, and analysed for plant nutrients. The nitrogen application has increased needle nitrogen content considerably, while it is much more difficult to change the concentration of other mineral nutrients in pine needles. (Fig. 5, Tab. 3).

5. Growth measurements

Two types of growth measurement have so far been made, viz. height growth measurements and diameter measurements. It is planned to make a biomass sampling at the next growth revision in 1974.

Examples of height growth measurements are given in figure 6. The various treatments seem to have had very little effect on height growth. Very probably there was a positive effect in 1970, one year after the first treatment. It is possible that this first positive effect was compensated by a negative effect in 1971.

The diameter measurements (by dendrometers or by calipers) give a very different picture. The diameter increase in a young tree depends very much on the size and vigour of a tree, and therefore a plot with a higher mean height before treatment will be expected to show a larger basal area. Also stand density will affect diameter growth. Bjørgung (1968) has shown that the growth of young stands is often linearly related to an index $\sqrt{n} \cdot H^2$ where n stands for the number of trees per unit area and H^2 for the mean height at start. Therefore, figures 7a-7g have been constructed with the Bjørgung index on the x-axis and basal area in 1971 on the y-axis. Figure 7h has instead the initial height on the x-axis. Figures 7a, 7g, 7h show rather clearly way that basal area is consistently higher on plots receiving nitrogen than on non-nitrogen than on non-nitrogen plots. On the other hand, there seems to be no indication, so far, that any of the other treatments has had a positive effect on basal area. The same conclusion can be drawn from figures 7b-7f which represent the results from the factorial experiment E41. Neither phosphorus, potassium, magnesium, sulphur nor micronutrients seems to have affected basal area so far.

6. Other measurements

There have been several other activities at Lisselbo apart from those mentioned above. Soil samples have been collected for faunal studies by Lohm and collaborators in Uppsala (1973). Soil nutrient

status and base saturation has been studied by S Odén in Uppsala (Tab. 4). A special study has been made of soil ammonification and nitrification on acidified and non-acidified plots by B Popović. Rather curious damage has been found on pine fertilised with nitrogen, with the highest frequency on plots receiving both lime and NPK. A Aronsson has studied this damage and found it to be caused by severe frost in early summer. Some of the fertiliser treatments including nitrogen have apparently made the pines more susceptible to frost injury (Aronsson, in prep.). Aronsson is also studying the seasonal variation in dry weight and nutrient content of pine needles at two different nutrient regimes.

7. Lysimeter installations (Tab. 1d)

It is well known that only a relatively small part of nutrients added is absorbed by forest trees in practical fertilisation. It can be expected that even less is taken up when fertilisation is repeated at frequent intervals, as at Lisselbo. It is therefore of considerable interest to study leaching (Overrein 1971). Another reason for studying leaching comes from the acidification experiment. The effect of acid precipitation on forest soil has been much discussed, and it is believed that if the increased supply of acid is harmful, this is due not to the pH decrease directly, but to the removal of valuable cations from the soil profile (Anonymous 1971). The lysimeters consist of plastic containers connected with polyethylene flasks by plastic tubing containing a terylene wick in order to make the water regime less artificial. The percolate is analysed at intervals. Also suction lysimeters have been installed on some of the plots; this installation is provided with an automatic suction regulation device.

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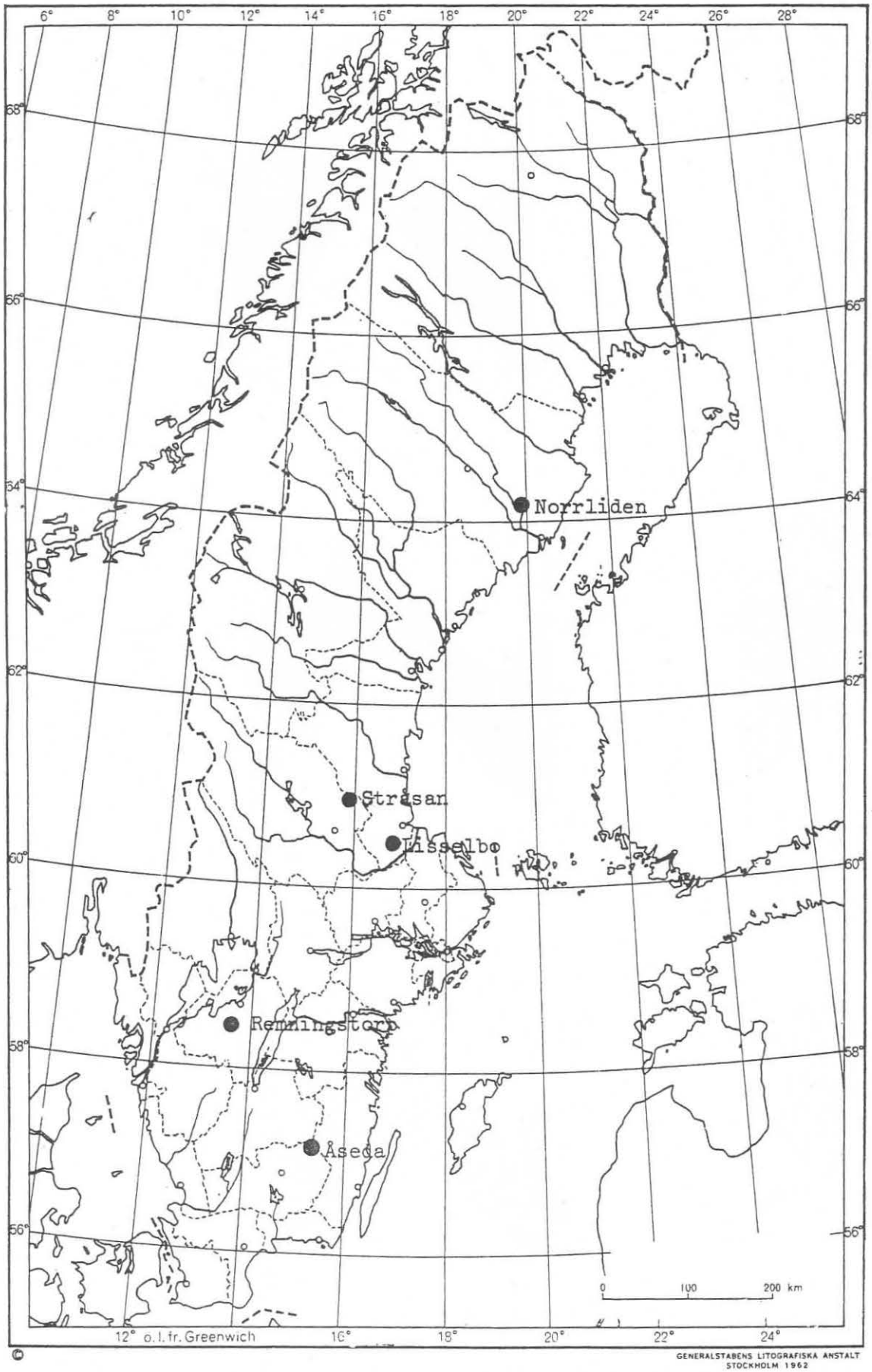


Fig. 1 Geographical location of the forest optimum nutrition experiments in Sweden.

Experimental area	Mean annual temp. °C	Annual precipitation mm
Norrliden	1.2	595
Stråsan	3.1	745
Lisselbo	4.8	593
Remningstorp	6.0	659
Åseda	6.4	596

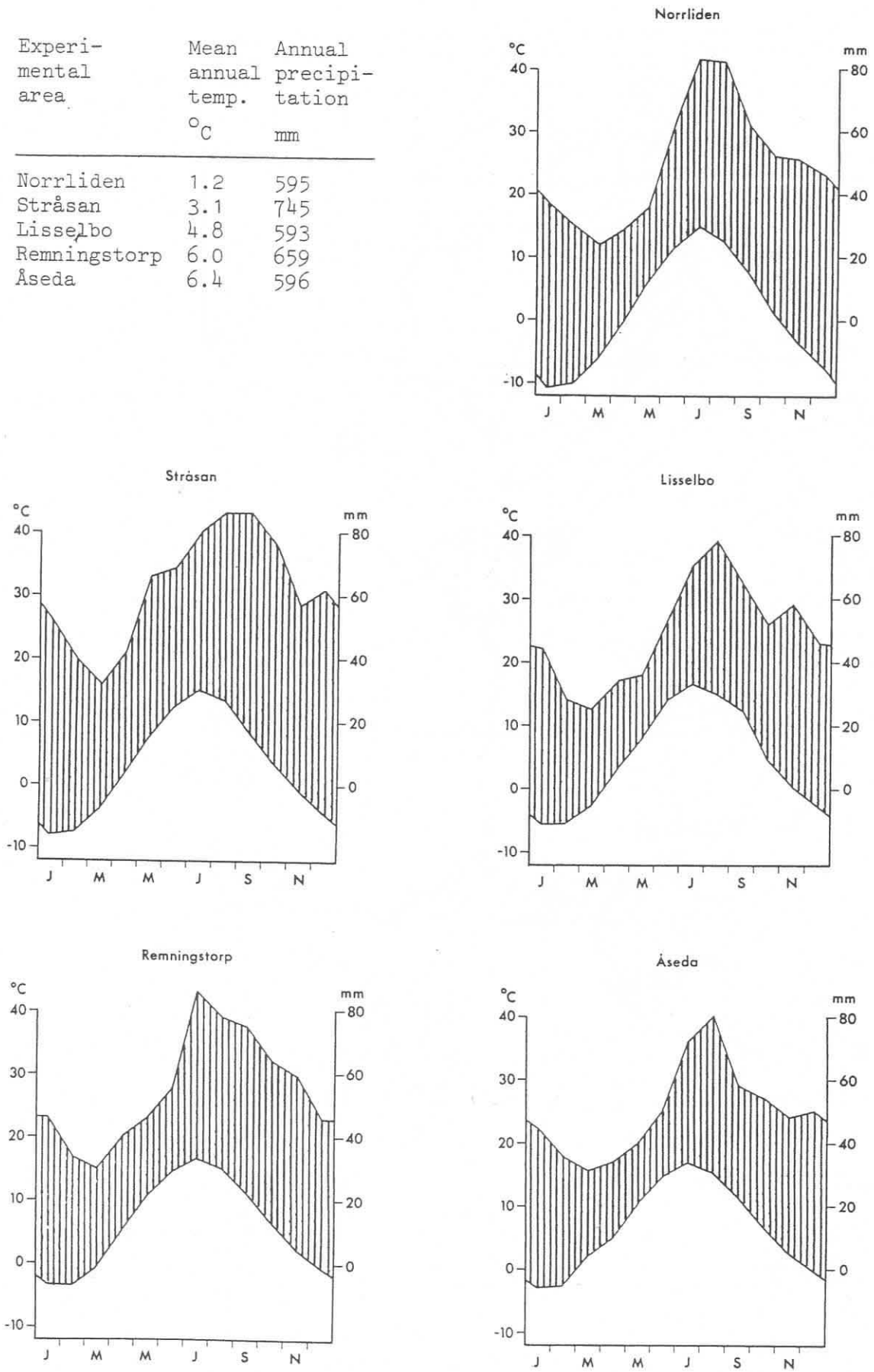
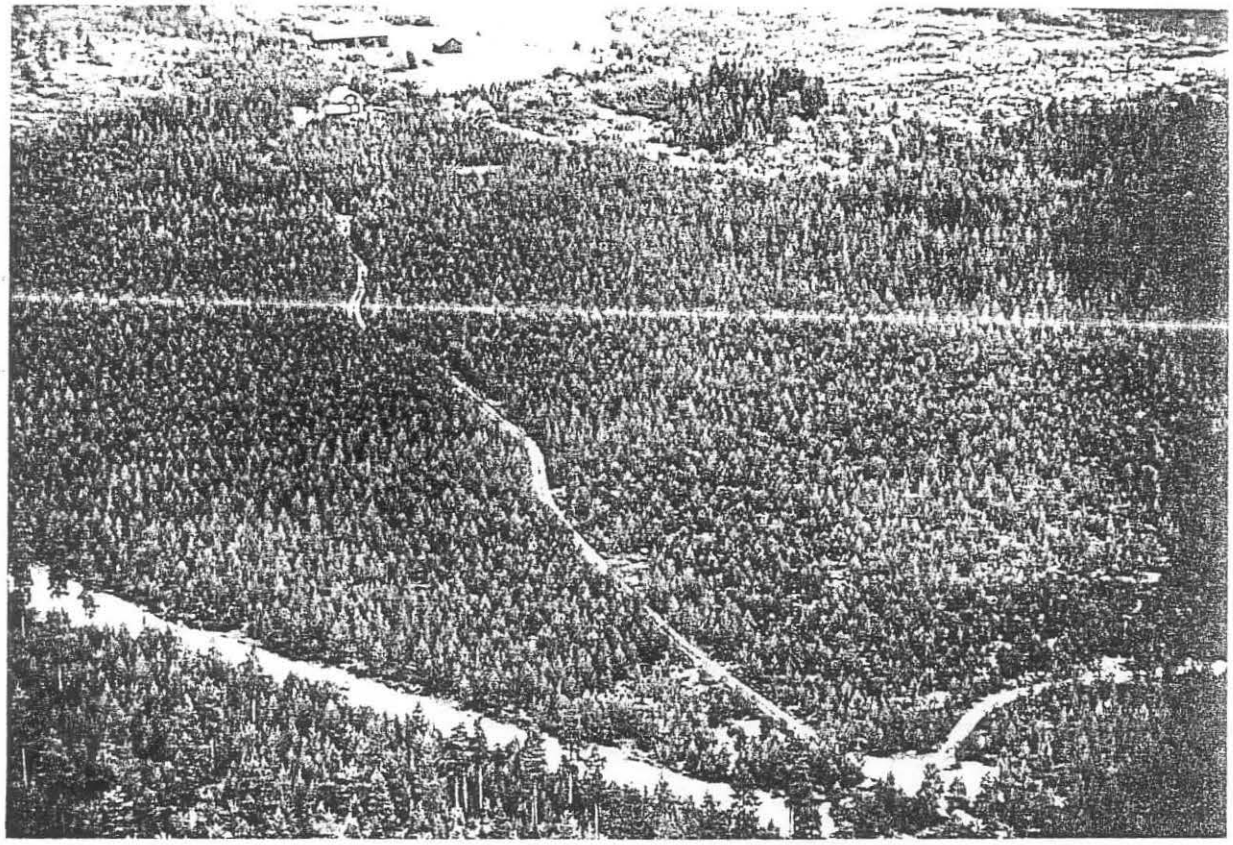
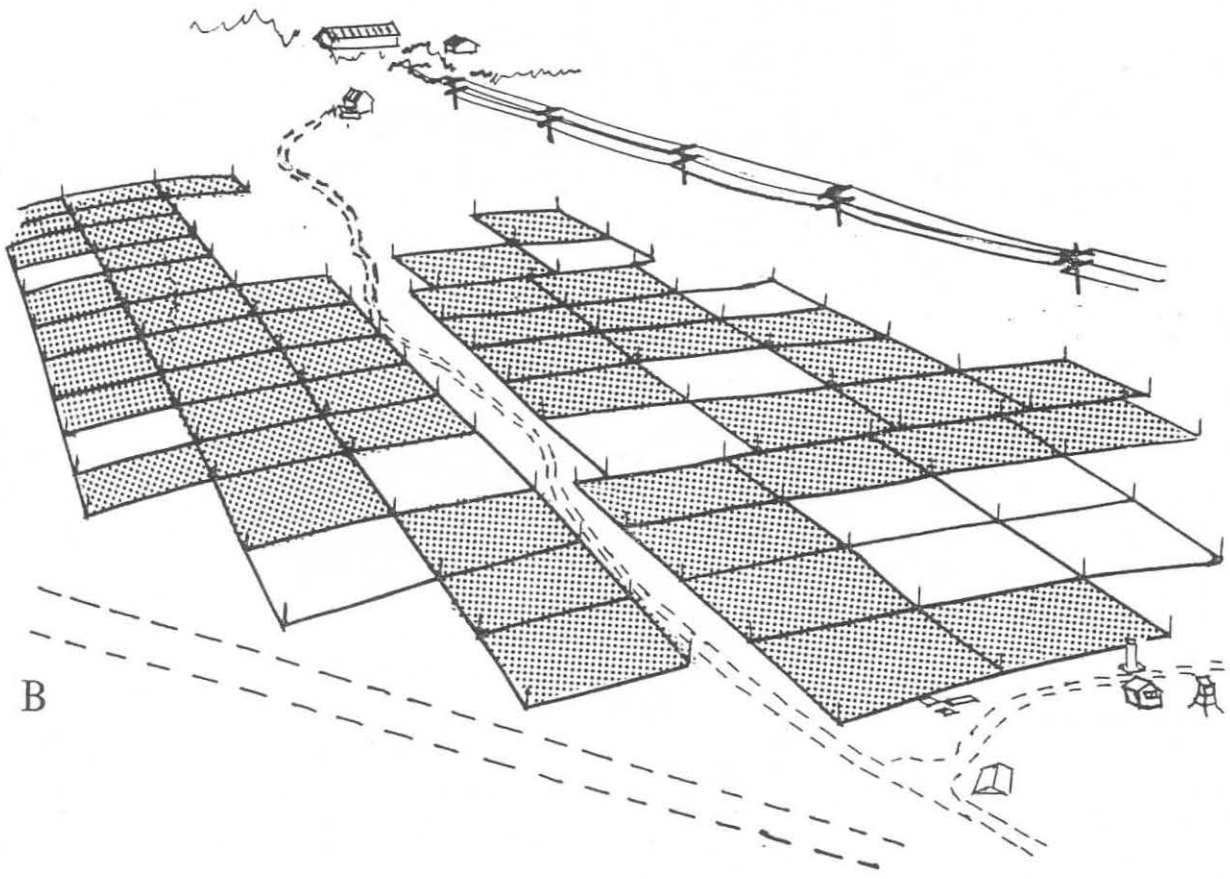


Fig. 2 Mean annual temperature, annual precipitation and climate diagram (cf Walter and Lieth 1961-67) for the forest optimum nutrition experiments in Sweden. Mean monthly temperatures (lower curve) and mean monthly precipitation (upper curve). Both curves are calculated as average for the period 1931-60 and average for meteorological stations near the various experiments.



A



B

Fig. 3 The experimental area Lisselbo. Aerial photo taken in summer 1973 (A). In figure 3B the plots treated with N are hatched.

E 40 - E 42 LISSELBO

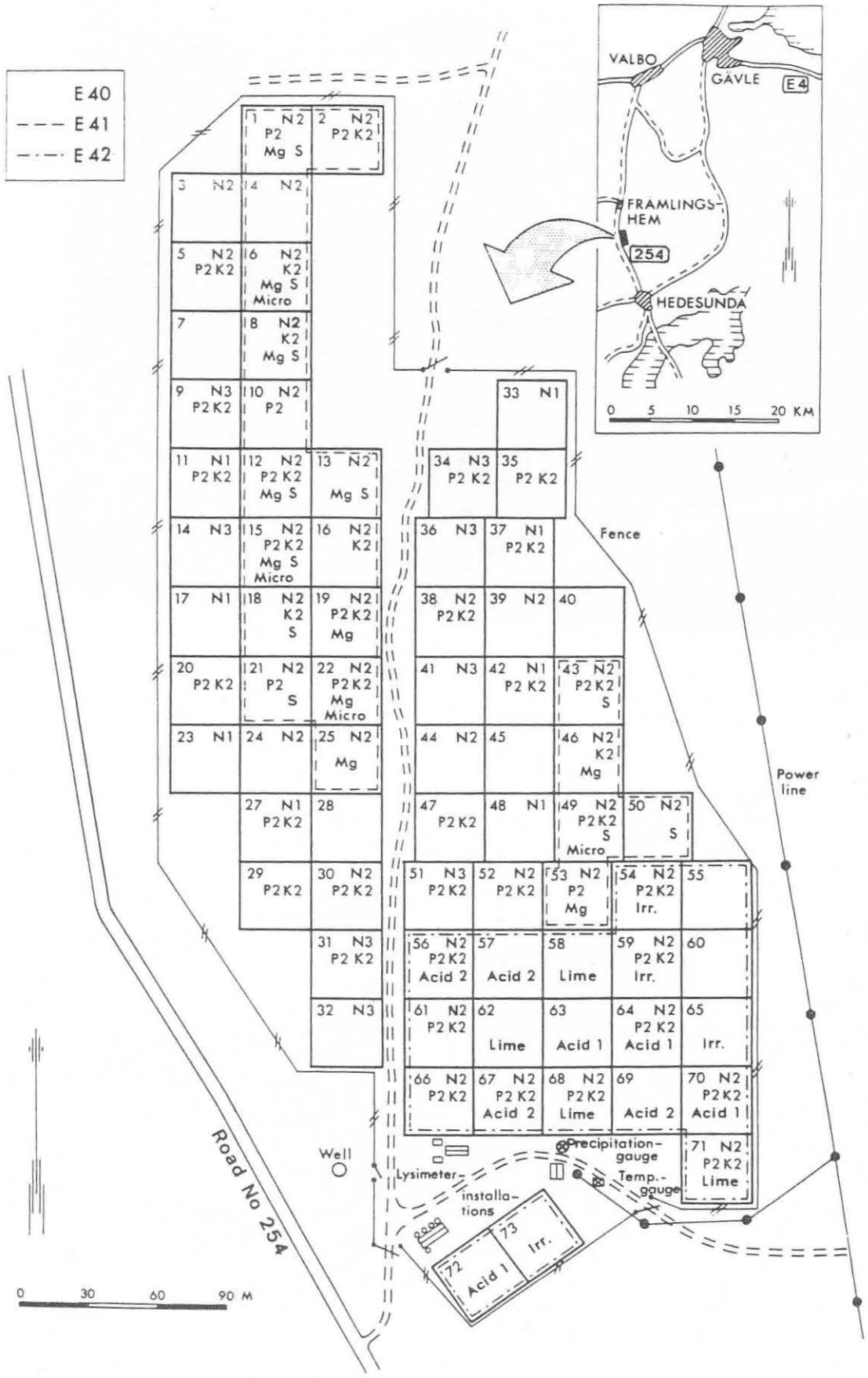


Fig. 4 Location of Lisselbo (inserted) and experimental plan. For fertiliser regimes, see Table 1.

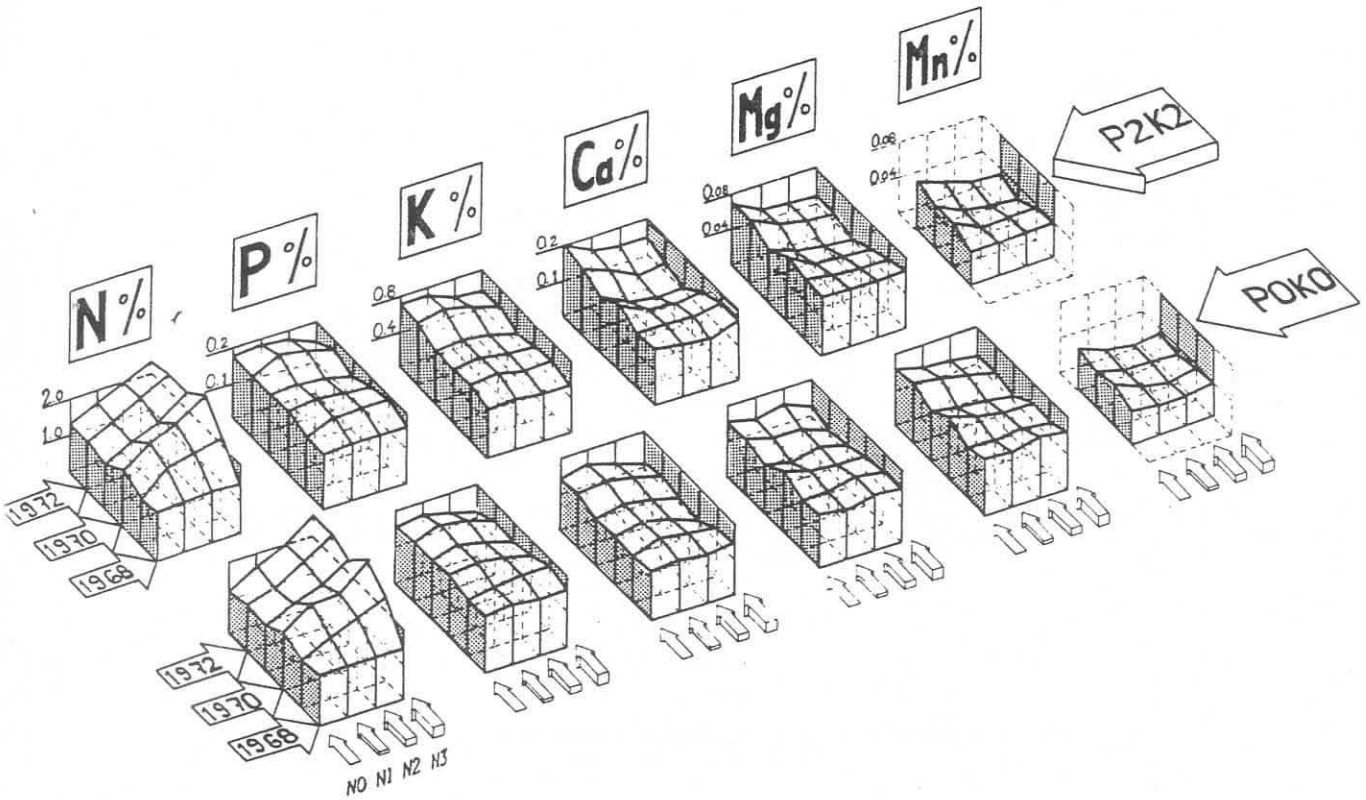


Fig. 5 Experiment E40. Nutrient concentrations in exposed current pine needles (per cent dry weight). Each value average for four plots.

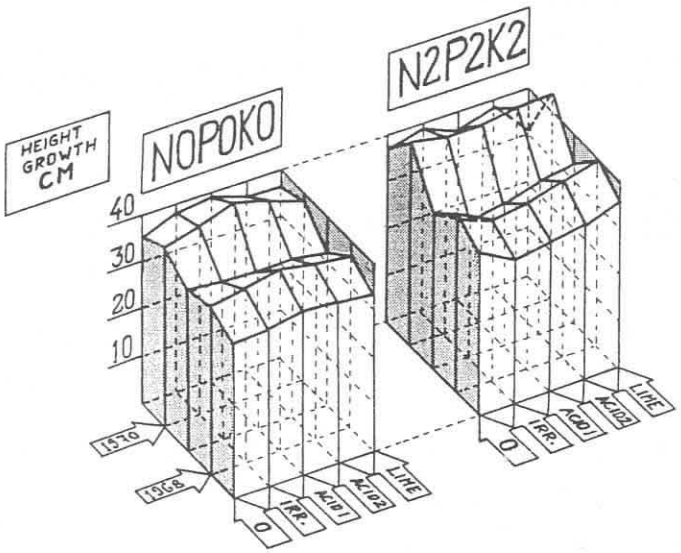


Fig. 6 Experiment E42. Height growth. Each value average for two plots.

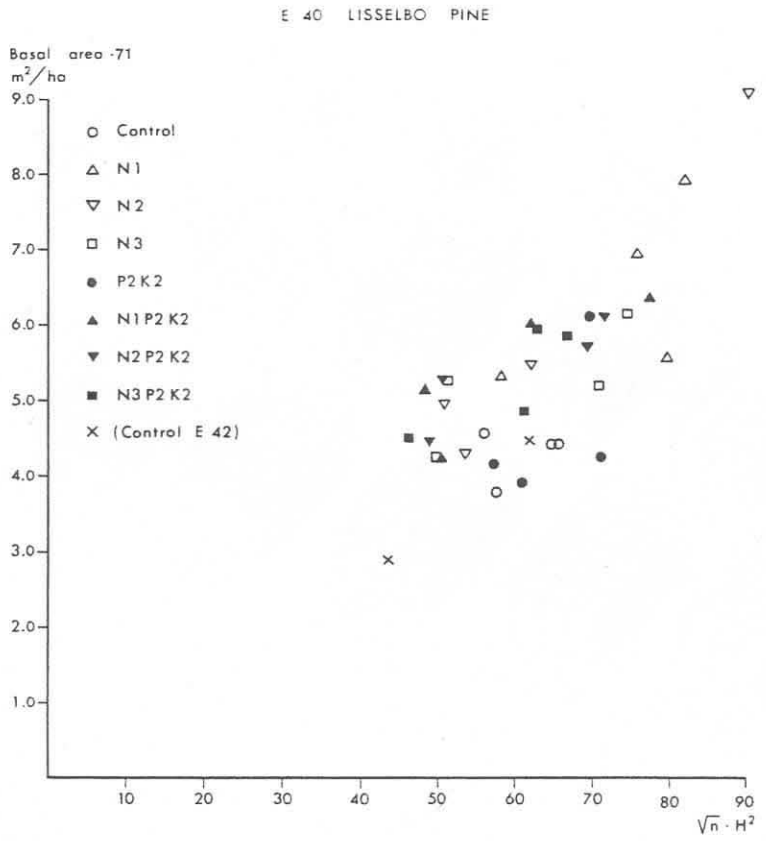


Fig. 7a Experiment E40. The basal area in 1971 as a function of initial stand conditions, expressed as $\sqrt{n} \cdot H^2$ (n = no. of trees, H = mean height 1968), see text.

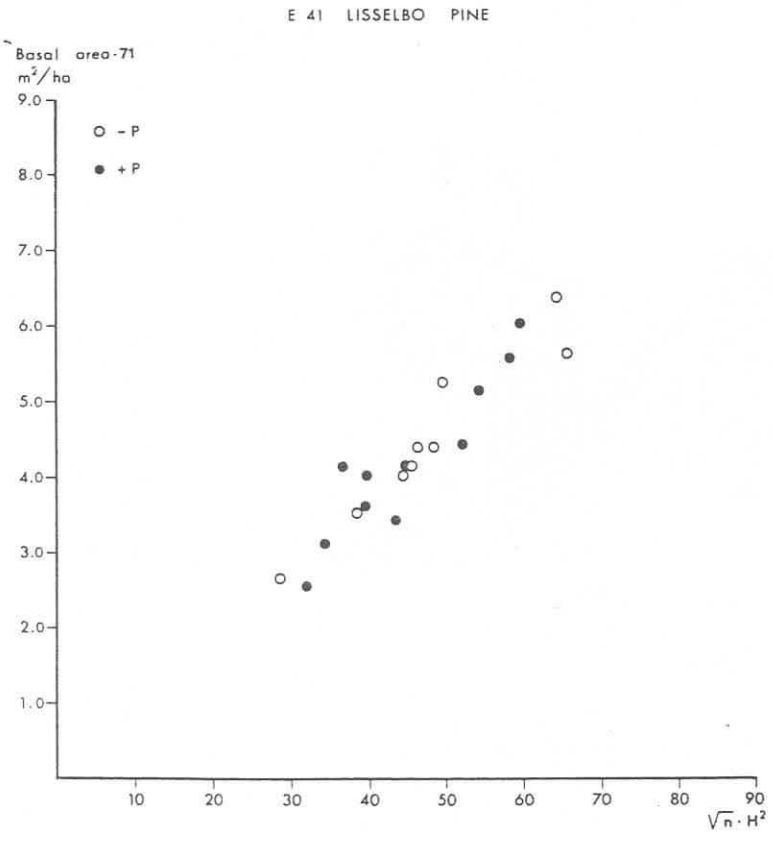


Fig. 7b E41. -P, +P.

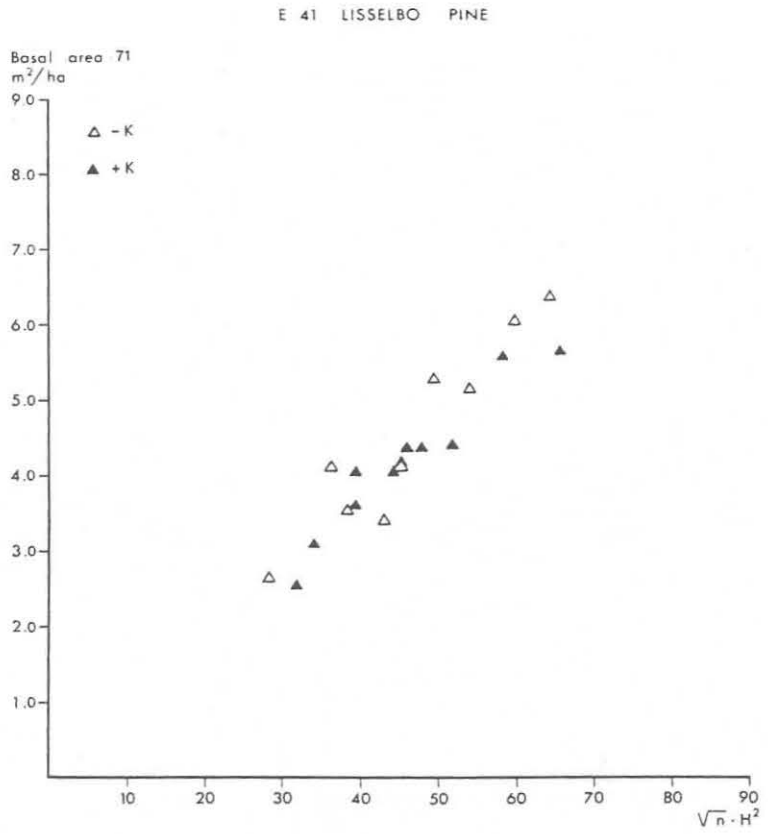


Fig. 7c E41. -K, +K.

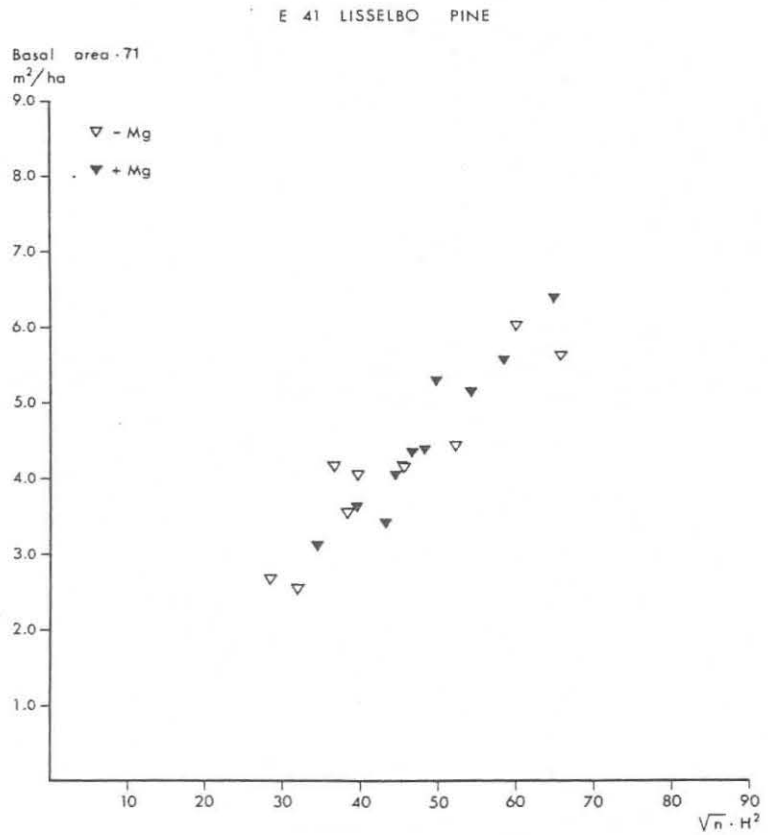


Fig. 7d E41. -Mg, +Mg.

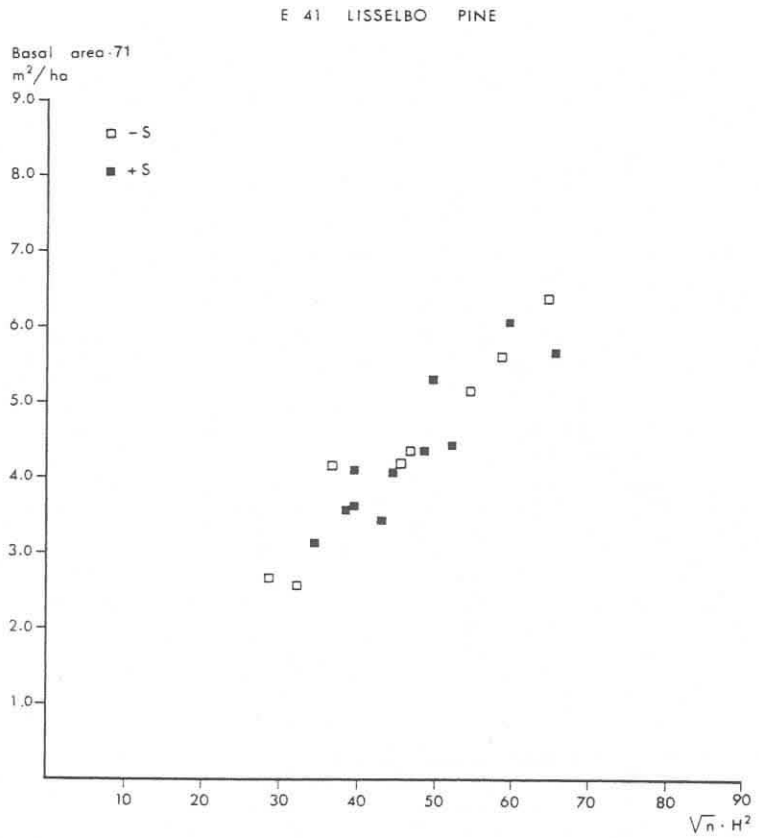


Fig. 7e E41. -S, +S.

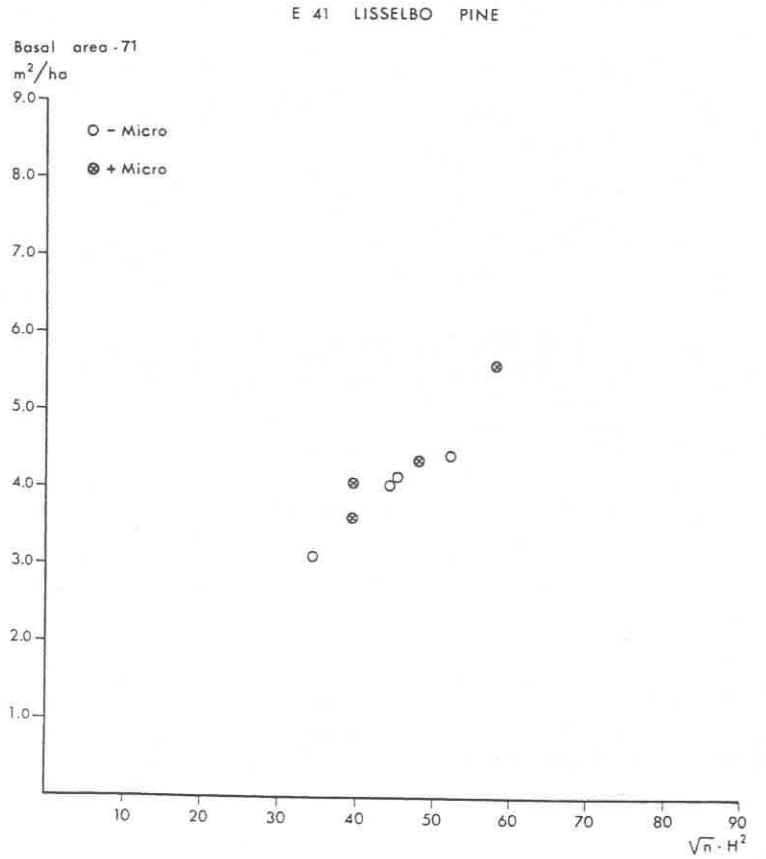


Fig. 7f E41. -Micro, +Micro.

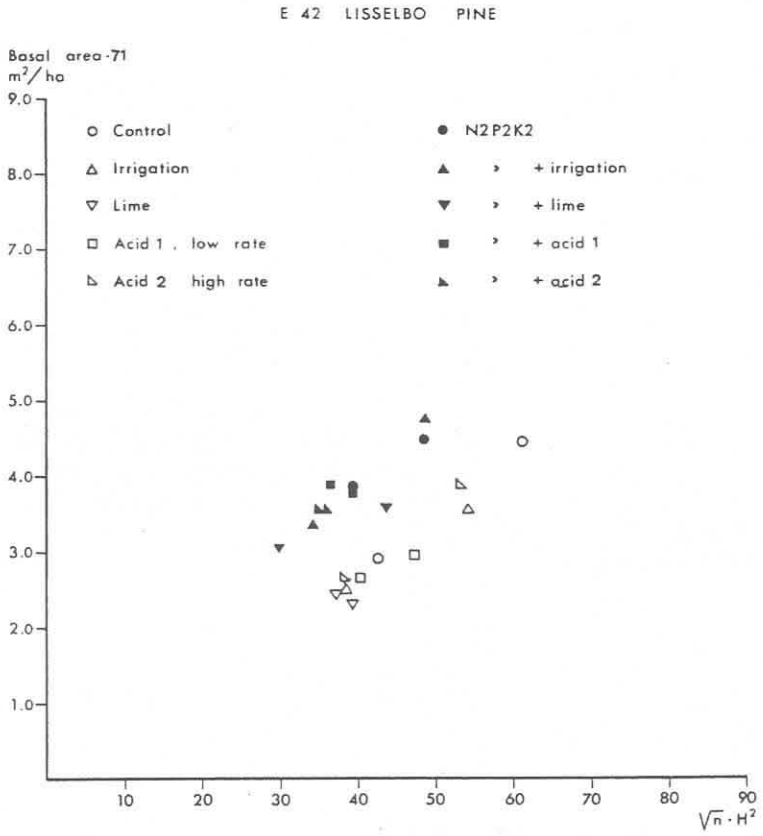


Fig. 7g E42.

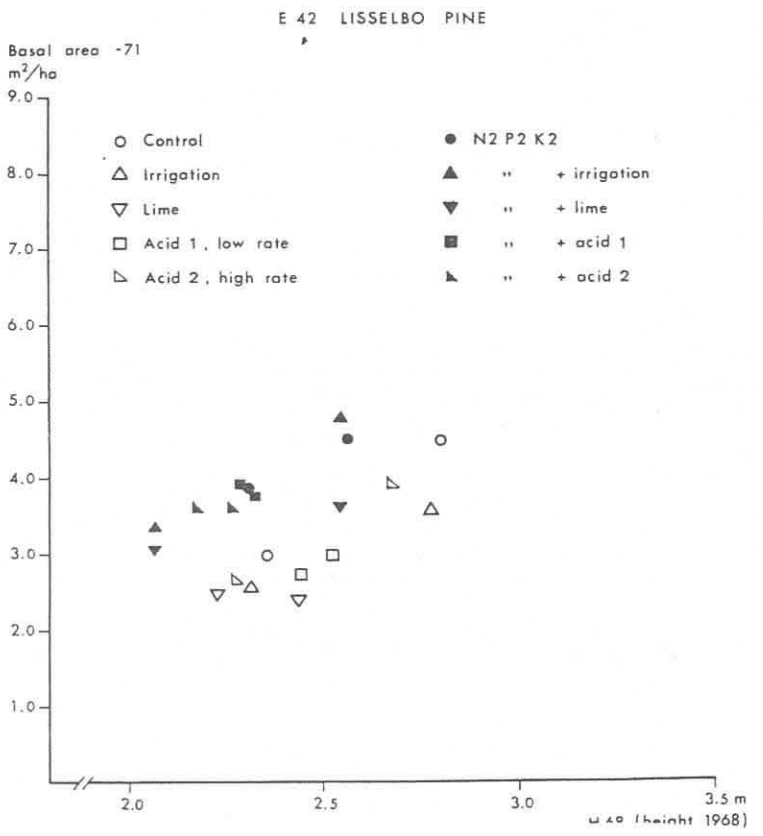


Fig. 7h E42. The basal area in 1971 as a function of height 1968.

Table 1a Experiment E40 Lisselbo. Fertiliser regimes

Treatment	Block No. and Plot No.			
	I	II	III	IV
0	40	7	28	45
N1	33	17	23	48
N2	39	3	24	44
N3	36	14	32	41
P2 K2	35	20	29	47
N1 P2 K2	37	11	27	42
N2 P2 K2	38	5	30	52
N3 P2 K2	34	9	31	51

Note: The data in Table 1a-1d are amounts of <u>elements</u> in kg per hectare, except for "Acid" in Table 1c and 1d which refers to the compound H_2SO_4.

	Ammonium-nitrate			Compound PK-fertiliser	
	kg per hectare				
	N1	N2	N3	P2	K2
1969	60	120	180	40	76
1970	60	120	180		
1971	40	80	120		
1972	40	80	120	20	38
1973	40	80	120		
1974	40	80	120		

Table 1b Experiment E41 Lisselbo. Fertiliser regimes

Treatment	Block No. and Plot No.			
	V	VI	VII	VIII
N2	1 2 4 6 8	10 12 13 15 16	18 19 21 22 25	43 46 49 50 53
P2	1 2	10 12 15	19 21 22	43 49 53
K2	2 6 8	12 15 16	18 19 22	43 46 49
Mg	1 6 8	12 13 15	19 22 25	46 53
S	1 6 8	12 13 15	18 21	43 49 50
Micro	6	15	22	49

	Ammonium-nitrate	Triple super-phosphate	Potassium-chloride	Magnesium-carbonate	Sodium-sulphate	
	kg per hectare					
	N2	P2	K2	Mg	S	
1969	120	40	80	50	40	
1970	120					Micro
1971	80					
1972	80	20	40			
1973	80			50	40	Micro
1974	80					

Table 1c Experiment E42 Lisselbo. Fertiliser regimes

Treatment	Block No. and Plot No.	
	IX	X
0	55	60
Irrigation	73	65
Acid 1	63	72
Acid 2	69	57
Lime	62	58
N2 P2 K2	66	61
N2 P2 K2 Irrigation	54	59
N2 P2 K2 Acid 1	70	64
N2 P2 K2 Acid 2	67	56
N2 P2 K2 Lime	68	71

	Ammonium-nitrate	Compound PK-fertiliser		Ground limestone	H_2SO_4	
	kg per hectare					
	N2	P2	K2	Ca	Acid 1	Acid 2
1969	120	40	76	1960		100
1970	120				50	50
1971	80				50	50+50
1972	80	20	38		50	50+50
1973	80				50	50+50
1974	80				50	50+50

Table 1d Lysimeter installations. Fertiliser regimes

Treatment	Block No. and Lysimeter No.			
	I	II	III	IV
0	5	16	19	37
Acid 2	7	12	22	40
Irrigation	8	11	17	41
Acid 2 Irr.	6	14	18	44
N2 P2 K2	3	15	23	42
N2 P2 K2 Acid 2	1	9	20	38
N2 P2 K2 Irrigation	2	13	21	43
N2 P2 K2 Acid 2 Irr.	4	10	24	39

	Ammonium-nitrate	Compound PK-fertiliser		H_2SO_4
	kg per hectare			
	N2	P2	K2	Acid 2
1972	120	40	76	50+50
1973	120			50+50
1974	120			50+50

Table 2 Experiment E42 Lisselbo
Nutrient status in October 1971 in the lake Fäbodsjön used for irrigation.

pH	Conductivity $\mu \cdot 10^{-6}$	mg/l								
		Na	K	Mg	Ca	NH_4-N	NO_2-N	NO_3-N	org-N	tot-N
5.9	36.2	1.87	0.57	0.87	3.66	0.02	0.00	0.00	0.29	0.31

TABLE 3 A EXPERIMENT E40 LISSELBO

NUTRIENT CONCENTRATIONS (PER CENT D.W.) IN EXPOSED CURRENT PINE NEEDLES. EACH VALUE AVERAGE FOR FOUR PLOTS.

		TREATMENT FROM 1969 ONWARDS							
		0	N1	N2	N3	P2K2	N1P2K2	N2P2K2	N3P2K2
N	1968	1.39	1.42	1.40	1.44	1.39	1.42	1.45	1.44
	1969	1.32	1.76	2.01	2.36	1.29	1.81	2.02	2.21
	1970	1.60	2.17	2.18	2.89	1.58	2.05	2.34	2.89
	1971	1.30	1.64	1.90	2.40	1.22	1.54	1.83	2.43
	1972	1.32	1.66	2.03	2.66	1.33	1.68	2.06	2.47
	1973	1.28	1.68	2.02	2.62	1.30	1.65	1.94	2.34
P	1968	0.160	0.167	0.159	0.160	0.157	0.159	0.161	0.161
	1969	0.158	0.165	0.175	0.175	0.157	0.184	0.189	0.188
	1970	0.175	0.181	0.174	0.155	0.175	0.186	0.178	0.168
	1971	0.165	0.181	0.164	0.141	0.172	0.175	0.168	0.148
	1972	0.164	0.188	0.178	0.153	0.174	0.208	0.192	0.175
	1973	0.157	0.164	0.145	0.126	0.174	0.182	0.178	0.144
K	1968	0.56	0.58	0.53	0.57	0.56	0.59	0.54	0.54
	1969	0.52	0.62	0.58	0.54	0.62	0.67	0.58	0.60
	1970	0.55	0.60	0.52	0.42	0.60	0.62	0.58	0.56
	1971	0.54	0.60	0.56	0.49	0.60	0.63	0.59	0.51
	1972	0.62	0.66	0.60	0.51	0.70	0.77	0.70	0.63
	1973	0.58	0.64	0.55	0.44	0.71	0.72	0.59	0.57
CA	1968	0.15	0.14	0.16	0.15	0.16	0.15	0.14	0.17
	1969	0.14	0.14	0.16	0.14	0.16	0.16	0.16	0.17
	1970	0.17	0.15	0.14	0.14	0.18	0.15	0.14	0.15
	1971	0.14	0.12	0.14	0.12	0.16	0.12	0.11	0.11
	1972	0.16	0.14	0.14	0.11	0.18	0.16	0.12	0.13
	1973	0.16	0.14	0.16	0.13	0.20	0.16	0.15	0.15
MG	1968	0.080	0.075	0.085	0.078	0.080	0.080	0.078	0.080
	1969	0.070	0.066	0.071	0.067	0.081	0.074	0.072	0.072
	1970	0.089	0.074	0.068	0.067	0.088	0.065	0.064	0.064
	1971	0.072	0.063	0.064	0.054	0.072	0.054	0.052	0.051
	1972	0.089	0.079	0.073	0.062	0.087	0.072	0.065	0.062
	1973	0.079	0.070	0.066	0.060	0.087	0.068	0.060	0.062
MN	1968								
	1969	0.036	0.035	0.033	0.040	0.038	0.038	0.038	0.039
	1970	0.047	0.036	0.030	0.038	0.050	0.037	0.037	0.037
	1971	0.043	0.033	0.032	0.030	0.050	0.034	0.029	0.028
	1972	0.048	0.036	0.033	0.036	0.056	0.043	0.036	0.036
	1973								

TABLE 3B EXPERIMENT E41 LISSELBO

NUTRIENT CONCENTRATIONS (PER CENT D.W.) IN EXPOSED CURRENT PINE NEEDLES. EACH VALUE AVERAGE FOR EIGHT PLOTS. PLUS AND MINUS MICRO FOR FOUR PLOTS.

		TREATMENT FROM 1969 ONWARDS									
		-P	+P	-K	+K	-MG	+MG	-S	+S	-MICRO	+MICRO
N	1968	1.41	1.40	1.39	1.42	1.41	1.40	1.40	1.41	1.43	1.41
	1969	2.14	2.03	2.14	2.01	2.07	2.10	2.02	2.15	2.08	2.12
	1970	2.54	2.55	2.60	2.49	2.57	2.52	2.55	2.54	2.46	2.35
	1971	2.09	2.14	2.12	2.12	2.12	2.11	2.11	2.12	2.09	2.03
	1972	2.30	2.13	2.23	2.20	2.22	2.20	2.22	2.21	2.16	2.04
	1973	2.19	2.06	2.15	2.08	2.14	2.09	2.12	2.10	2.14	2.02
P	1968	0.161	0.158	0.159	0.160	0.160	0.160	0.159	0.160	0.160	0.160
	1969	0.181	0.188	0.182	0.187	0.184	0.185	0.178	0.191	0.194	0.186
	1970	0.166	0.182	0.173	0.175	0.176	0.172	0.174	0.174	0.179	0.172
	1971	0.161	0.170	0.163	0.168	0.170	0.160	0.164	0.166	0.172	0.167
	1972	0.163	0.192	0.174	0.181	0.181	0.174	0.175	0.181	0.185	0.169
	1973	0.139	0.165	0.152	0.156	0.160	0.140	0.155	0.154	0.171	0.144
K	1968	0.58	0.57	0.59	0.56	0.57	0.58	0.58	0.57	0.57	0.55
	1969	0.59	0.60	0.57	0.63	0.62	0.58	0.58	0.62	0.62	0.62
	1970	0.54	0.56	0.50	0.60	0.56	0.54	0.55	0.55	0.61	0.70
	1971	0.54	0.52	0.48	0.58	0.51	0.55	0.50	0.56	0.60	0.59
	1972	0.63	0.63	0.56	0.70	0.62	0.64	0.61	0.65	0.72	0.70
	1973	0.55	0.62	0.53	0.63	0.57	0.60	0.54	0.62	0.62	0.67
CA	1968	0.14	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.14
	1969	0.15	0.16	0.16	0.15	0.15	0.16	0.16	0.15	0.16	0.15
	1970	0.15	0.14	0.14	0.15	0.14	0.15	0.14	0.15	0.15	0.16
	1971	0.12	0.11	0.11	0.12	0.11	0.12	0.11	0.12	0.12	0.11
	1972	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12
	1973	0.13	0.14	0.13	0.14	0.13	0.14	0.13	0.14	0.13	0.14
MG	1968	0.076	0.080	0.078	0.078	0.077	0.079	0.076	0.080	0.075	0.073
	1969	0.069	0.074	0.074	0.069	0.070	0.073	0.072	0.071	0.068	0.071
	1970	0.067	0.067	0.067	0.067	0.065	0.069	0.068	0.066	0.067	0.069
	1971	0.056	0.058	0.058	0.056	0.054	0.060	0.059	0.055	0.055	0.056
	1972	0.068	0.068	0.072	0.064	0.063	0.073	0.069	0.068	0.066	0.059
	1973	0.065	0.065	0.068	0.064	0.061	0.068	0.067	0.064	0.064	0.062
MN	1968										
	1969										
	1970	0.035	0.034	0.031	0.038	0.035	0.034	0.034	0.035	0.038	0.045
	1971	0.030	0.030	0.026	0.034	0.029	0.029	0.029	0.031	0.036	0.036
	1972	0.037	0.035	0.035	0.037	0.036	0.036	0.034	0.038	0.038	0.039
	1973										

TABLE 3C EXPERIMENT E42 LISSELBO

NUTRIENT CONCENTRATIONS (PER CENT D.W.) IN EXPOSED CURRENT PINE NEEDLES. EACH VALUE AVERAGE FOR TWO PLOTS.

		TREATMENT FROM 1969 ONWARDS (IRRIGATION FROM 1970 ONWARDS)									
			IRR.	ACID1	ACID2	LIME	N2P2K2	N2P2K2 +IRR.	N2P2K2 +ACID1	N2P2K2 +ACID2	N2P2K2 +LIME
N	1968	1.32	1.37	1.44	1.38	1.40	1.36	1.32	1.34	1.41	1.41
	1969	1.16	1.13	1.28	1.14	1.19	1.68	2.00	2.12	1.42	1.92
	1970	1.28	1.42	1.46	1.38	1.44	2.12	2.48	2.50	2.26	2.18
	1971	0.98	1.20	1.12	1.10	1.10	1.70	1.88	2.03	1.84	1.70
	1972	1.21	1.22	1.18	1.25	1.30	1.85	1.94	2.12	1.99	1.90
	1973	1.20	1.12	1.16	1.15	1.18	1.88	1.80	1.94	1.88	1.99
P	1968	0.150	0.154	0.153	0.144	0.150	0.150	0.140	0.151	0.149	0.152
	1969	0.132	0.145	0.152	0.150	0.152	0.204	0.180	0.173	0.201	0.188
	1970	0.150	0.159	0.150	0.145	0.148	0.162	0.162	0.174	0.161	0.166
	1971	0.201	0.162	0.174	0.178	0.168	0.149	0.148	0.160	0.143	0.156
	1972	0.147	0.156	0.154	0.144	0.159	0.164	0.180	0.154	0.149	0.188
	1973	0.150	0.166	0.178	0.159	0.168	0.170	0.152	0.177	0.160	0.192
K	1968	0.55	0.52	0.53	0.56	0.50	0.54	0.52	0.48	0.54	0.55
	1969	0.58	0.55	0.57	0.54	0.57	0.60	0.64	0.56	0.56	0.64
	1970	0.57	0.54	0.52	0.58	0.59	0.64	0.55	0.64	0.58	0.64
	1971	0.66	0.56	0.51	0.60	0.62	0.63	0.49	0.56	0.57	0.67
	1972	0.59	0.62	0.63	0.66	0.66	0.60	0.60	0.66	0.67	0.70
	1973	0.62	0.58	0.57	0.62	0.62	0.62	0.60	0.54	0.65	0.54
CA	1968	0.16	0.16	0.16	0.14	0.14	0.15	0.16	0.15	0.14	0.14
	1969	0.14	0.14	0.15	0.14	0.14	0.14	0.19	0.18	0.16	0.16
	1970	0.18	0.20	0.20	0.18	0.17	0.15	0.16	0.14	0.14	0.13
	1971	0.14	0.16	0.16	0.14	0.16	0.09	0.10	0.10	0.10	0.10
	1972	0.14	0.17	0.15	0.14	0.18	0.12	0.16	0.14	0.12	0.14
	1973	0.18	0.16	0.15	0.14	0.16	0.13	0.14	0.13	0.13	0.17
MG	1968	0.085	0.086	0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.074
	1969	0.073	0.081	0.082	0.086	0.081	0.072	0.074	0.074	0.074	0.076
	1970	0.078	0.095	0.095	0.088	0.088	0.068	0.060	0.064	0.062	0.064
	1971	0.070	0.078	0.079	0.076	0.080	0.046	0.042	0.044	0.043	0.045
	1972	0.087	0.096	0.087	0.086	0.090	0.064	0.063	0.066	0.060	0.067
	1973	0.073	0.074	0.072	0.064	0.074	0.050	0.046	0.047	0.046	0.056
MN	1968										
	1969	0.038	0.034	0.042	0.043	0.041	0.046	0.043	0.044	0.040	0.046
	1970	0.046	0.045	0.053	0.046	0.043	0.037	0.039	0.038	0.037	0.030
	1971	0.048	0.041	0.043	0.048	0.038	0.024	0.022	0.024	0.022	0.020
	1972	0.056	0.052	0.054	0.057	0.044	0.038	0.040	0.041	0.038	0.035
	1973	0.046	0.042	0.044	0.040	0.027	0.030	0.024	0.028	0.028	0.021

Table 4 Experiment E42 Lisselbo

Nutrient status, exchange capacity and degree of base saturation in the A_o-horizon. Soil samples collected in May 1971, analysed at the College of Agriculture (S Odén).

Treatment	Plot No.	pH	"Buffer capacity" Δ me/Δ pH	kg equivalent per hectare							% degree of base saturation (S/T · 100)
				Na	K	Mg	Ca	Sum "S"	H	exchange capacity "T"	
Control	55	3.0	10.7	0.18	0.34	0.71	4.34	5.6	40.4	45.9	12.1
	60	3.1	11.9	0.21	0.26	0.50	3.67	4.6	33.4	38.0	12.2
	Average	3.1	11.3	0.20	0.30	0.60	4.00	5.1	36.9	42.0	12.2
Irrigation	73	3.1	8.0	0.14	0.13	0.33	2.24	2.8	19.8	22.7	12.5
	65	3.0	10.0	0.21	0.22	0.39	2.84	3.7	26.2	29.9	12.2
	Average	3.0	9.0	0.18	0.18	0.36	2.54	3.2	23.0	26.3	12.4
Acid 1	63	3.0	11.0	0.09	0.25	0.50	3.25	4.1	31.2	35.3	11.6
	72	3.3	8.4	0.19	0.24	0.42	3.22	4.1	23.7	27.8	14.7
	Average	3.2	9.7	0.14	0.24	0.46	3.24	4.1	27.4	31.5	13.1
Acid 2	69	3.0	11.4	0.20	0.30	0.42	3.35	4.3	38.3	42.6	10.0
	57	3.0	10.0	0.17	0.30	0.41	2.65	3.5	30.7	34.3	10.3
	Average	3.0	10.7	0.18	0.30	0.42	3.00	3.9	34.5	38.4	10.2
Lime	62	6.2	26.7	0.14	0.24	0.83	17.84	19.1	0	19.1	100.0
	58	6.3	40.0	0.24	0.33	1.43	30.66	32.7	0	32.7	100.0
	Average	6.2	33.4	0.19	0.28	1.13	24.25	25.9	0	25.9	100.0